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ABSTRACT

The National Aeronautics and Space Administration (NASA) has produced a distance learning series of four 60-minute video programs with an accompanying Web site and companion teacher guide. This teacher guide accompanies the first video in the series. The story line of each program involves six ethnically diverse, inquisitive schoolchildren who meet in a treehouse. They seek the solution to a particular problem, and the NASA "Why?" Files series follows them through the steps of their investigation and final conclusion. In the first program, the friends in the treehouse learn that a nearby town is being bothered by an unpleasant odor, and viewers are invited to assist with solving the problem of the unknown source of the odor. The program includes a visit by the treehouse friends to a NASA Langley electronics engineer to learn about scientific research. Students learn the necessity of identifying the problem, gathering data, forming a hypothesis, testing the hypothesis, controlling the variables, analyzing the data, and reaching a conclusion. The teacher guide includes a program overview, science and mathematics concepts as related to the National Standards, key vocabulary, and program discussion. In addition, the guide includes extension activities across disciplines designed for classroom or home/family enrichment. This guide also offers suggestions for the most effective use of the videos and web site in the classroom, as well as a description of the Web site programs. (PVD)

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ED 459 065

# The NASA "Why?" Files
# The Case of the Unknown Stink

Program 1 in the 2000-2001 Series

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The NASA "Why?" Files
whyfiles.larc.nasa.gov

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NASA

| Educator's Guide | |
|---|---|
| Teachers & Students | Grades 3-5 |

EP-2000-09-20-LaRC

Production of the NASA "Why?" Files is made possible by the generous support provided by AIAA Foundation; Busch Gardens, Williamsburg; Hampton City Public Schools; and the NASA Langley Research Center's Learning Technology Project and Aerospace Vehicle Systems Technology Program Office.

The American Institute of Aeronautics and Astronautics (AIAA) provides classroom mentors to educators who register for the NASA "Why?" Files. Every effort will be made to match a teacher with an AIAA member who will mentor the teacher either in person or by e-mail. To request a mentor, e-mail nasawhyfiles@aiaa.org or call Lisa Bacon at (703) 264-7527.

AIAA FOUNDATION

*Contact the AIAA to get a classroom mentor at nasaconnect@aiaa.org.*

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# The Series
## Overview

*The NASA "Why?" Files, offered by NASA Langley's Office of Education as a distance learning initiative, is a series of four 60-minute video programs with an accompanying web site and teacher guide.*
*The series is designed to enhance the teaching of science in grades 3-5. The program content is drawn from physical science, Earth science, life-biological space science, and computer science; supports the National Science Teachers Association (NSTA) Standards; and reflects the National Council of Teachers of Mathematics (NCTM) Standards. The series implements inquiry-based learning and focuses on the application of the scientific method. Each program is designed to model how children use the scientific method to solve problems and includes such process skills as gathering and classifying data, establishing hypotheses, designing experiments, identifying variables, measuring, observing, predicting, and communicating results. Students simultaneously learn subject matter and develop process skills while engaging in solving real-world problems. The problem-based learning practices enable the students to become proactive and critical thinkers capable of self-guidance and assessment when involved in a problem-solving situation.*

*The videos are fast paced, include animation, have a musical opening and closing, and are planned to appeal to children aged 8-10. The story line has six ethnically diverse, inquisitive school children (ages 10, 11, and 12; three males and three females), who are friends that meet in a tree house belonging to one of the children. They seek the solution to a particular problem, and the NASA "Why?" Files series follows them through the steps of their investigation and final conclusion. A companion teacher guide is available for each video program in the series. Each guide includes the program overview, related science and mathematics concepts, key vocabulary, and program discussion. In addition, the guide includes extension activities and web site information designed for classroom or home/family enrichment.*

*The NASA "Why?" Files web site provides a learner-centered environment in which the educator monitors, questions, and challenges, while students construct meaning and direction that will lead to a solution.*
*To get to a solution, students go through the following stages: understanding the problem, learning about the problem, solving the problem, and reflecting on the process used to solve the problem. This process helps students develop crucial problem solving skills to become life-long learners.*

*The NASA "Why?" Files is delivered to school districts and educators by PBS instructional television, can be downlinked from satellite, and is webcast via the NASA Learning Channel. Off air rights are granted in perpetuity. The teacher guides are not copyrighted and are free for educators. Copies of the teacher guide may be downloaded at the NASA "Why" Files web site http://whyfiles.larc.nasa.gov. Video copies of the NASA "Why?" Files are available from each NASA ERC and my be purchased from NASA CORE.*

# The Series

## Program Preparations

To generate student interest and to enhance the educational value of the program series, introduce each tape as you would any video or literature selection. Use the program summary for introductory ideas. List the key vocabulary words on the chalkboard or on a chart. Either go over the words and the meanings before presenting the video, or remind the students to listen carefully for the words as they view the video so that the words and their meanings can be discussed after viewing.

Keep the following in mind:

(1) The series may be used, with the appropriate teacher follow-up instruction, to introduce the scientific method or to supplement/culminate previous classroom instruction and materials relative to the scientific method.

(2) What's the Stink? (Program 1) should be used first since the story characters, the problem to be solved, and the scientific method will be introduced.

(3) The remaining programs should be used as they relate to the teacher's curriculum.

(4) The discussion questions and extension activities should be selected and/or adapted as appropriate for the developmental level of the students.

Each teacher guide reflects the content of a particular 15-minute segment of the 1-hour per program series. Adjust the information and activities in the guide according to the program segments used at a given time.

Encourage the students to use the NASA "Why?" Files web site for enrichment and technology application. The web site should generate student interest in exploring the use of the technology independently, rather than as a classroom instructional activity to obtain specific scientific information. The web page also contains some activities that families can enjoy together at home.

## Program Components

*The teacher guide for each of the four videos in the program series contains the following:*

- *Series Overview*
- *Program Preparation*
- *Program Overview*
- *Science Concepts*
- *Mathematics Concepts*
- *Key Science Vocabulary*
- *Program Discussion*
  - *Before Viewing*
  - *After Viewing*
- *Program Extensions*
- *NASA "Why?" Files Web Site Information*

# The Series

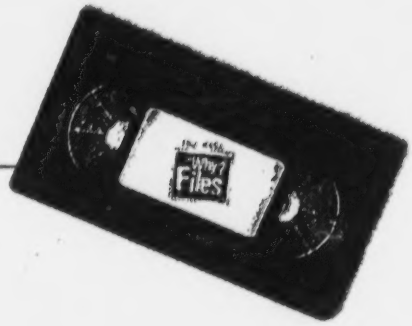
## Preparations for Using the Program

Research has shown that when technologies such as video and the Internet are integrated into the curriculum, a student-centered and interactive learning environment can be achieved. By integrating technology with existing curriculum, technology tools become an effective educational resource rather than one more component to fit into an already packed agenda. The design of the NASA "Why?" Files video and web site promotes a "marriage" of the two technologies. The video and web site are developed to address the national standards and provide students with an opportunity to enhance their science, mathematics, and educational technology skills.

## Suggestions for Effective Use of the Video

To generate student interest and to enhance the educational value of the series, introduce each 15-minute program segment by using the Program Discussion to generate introductory ideas. Display the key vocabulary words and discuss the definitions. Remind the students to listen carefully for the words as they view the instructional program and to be prepared to discuss the vocabulary definitions after viewing.

The series can be used to introduce the scientific method and to supplement previous classroom instruction. Discussion questions and extension activities provided in the teacher guide can be adapted to the developmental level of the students. The teacher guide supports the instructional content of each 15-minute segment by providing a variety of related educational experiences for the students. Programs and their segments may be videotaped and shown at times that enhance instruction of a particular concept or topic.



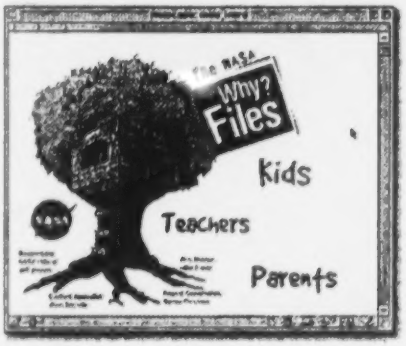

## Some Approaches for Using the Program in the Classroom

- View one 15-minute segment and incorporate the lesson guide worksheets, on-line activities/experiments, and home activities/experiments.
- View all four segments of the video sequentially and then follow up with the lesson guide worksheets, on-line activities/experiments, and home activities/experiments according to each student's needs.
- View an individual segment to help introduce or reinforce a particular content area/concept that you are currently teaching in an existing unit.

# The Series

## The NASA "Why" Files Web Site

Encourage students to use the NASA "Why?" Files web site for enrichment and additional instructional enhancement. The web site should generate student interest in exploring the topics presented in the programs and develop technology skills. The web site also contains activities students can share at home.




http://whyfiles.larc.nasa.gov

## Web Site Components

### Research Rack

- Facilitates internet searches on specific content
- Is an access point for summary information and glossary terms about the show's topic
- Is a point of reference for NASA research and missions

### Dr. D's Lab

- Is a resource for assignments and exploration for each section of the video
- Offers family or classroom resources for experiments and exploration activities

### Problem Board

- Collection of interactive activities where students apply their technology skills and science inquiry skills

### NASA "Why?" Files Club

- Incorporates technology skills
- Contains the tree house detectives' biographies

### Feedback

- Has on-line evaluation of the NASA "Why?" Files
- Encourages students to create their own web evaluation form that they can use at home to ensure their on-line time is spent on quality sites

### Media Zone

- A resource for sound clips, animation, and screen savers to enhance on-line electronic presentations

### Experts' Corner

- Encourages career exploration
- Inspires students to define their roles within the school or community and to share an experience of how someone motivated them to pursue a hobby, sport, or practice
- Provides practice using spreadsheets to catalog professional information that can be used as a resource for career week, writing biographies, or writing a paper that compares and contrasts various professions

# The Case of the Unknown Stink

## Effective Integration of the Video and the Web Site

Suggestions for effective integration of the NASA "Why?" Files video, the *Case of the Unknown Stink*, and the NASA "Why?" Files web site:

- Worksheets will be located in the teacher and parent portions under Resources.
- Home activities will be located in Dr. D's Lab area inside the tree house.
- Problem-based learning and video enrichment on-line activities will be located in the tree house at the Problem Board.

**Part 1: What's the Stink?**

- Students can take notes during the segment by using the on-line worksheet Question and Answer Data Collection Table found in the teacher resource portion of the web site.
- Students can complete the on-line worksheet, *Can We Make Sense of Our Senses*, as a cooperative activity with another student. This activity may be used as a warm-up activity prior to the video or as a closure activity as part of the learning extensions.
- Students can complete the home activities *Where's the Odor?* and/or *Sweet Smells 101* as a home work assignment, as extra credit, or as a classroom activity.
- Students can visit the Internet Resources inside the Research Rack and read a news article by NASA that highlights a technological invention, the "Electronic Nose." An image of the "Electronic Nose" is also available from JPL at http://www.jpl.nasa.gov/news

  See NASA's Jet Propulsion Lab News Release of June 6, 2000 at http://www.jpl.nasa.gov/pictures/tech/enose/ (Electronic Nose picture and caption)

**Part 2: Search for the Stink**

- Students can take notes during the video by using the on-line worksheet, *Using the Scientific Process*. After each segment, pause and discuss the scientific process steps students took or task them with completing the worksheet in small groups after viewing the video segments.
- Students can complete the on-line worksheet, *Writing a Hypothesis*, as a classroom activity or as homework.
- Students can complete the home activity, *Eye on the Environment*, as a homework assignment or an extra credit activity.
- Students can implement the Science Journal Writing home activity in the classroom or at home. It may also be placed in their student portfolio for later growth assessment. *Note: By emphasizing journal writing in the classroom, students will develop an understanding of the importance of continuing the practice at home.*
- Students can visit an internet resource found at the Research Rack that pertains to animals and their sensing abilities to gain additional information about how animals use their sense of smell. http://www.faculty.washington.edu/chudler/amaze.html

## Effective Integration of the Video and the Web Site, "Continued"

**Part 3: We're Almost There**

- Students can extend the concept of variables by completing the *Identifying Variables* on-line worksheet. The worksheets will help students make the connection between variables and other real world situations.

- Students can complete the home activity, *Designing a Wind Vane*, and use the wind vane to collect and record data over a period of time. The data can then be organized and communicated in graph form as part of an extension activity for the unit or another unit dealing with weather.

- Students can complete the home activity, *Smelly Traveler*, in class, as an investigation for a lab activity/grade, or as a homework assignment.

  Students can visit two Internet resources found at the Research Rack. Each pertains to kids' health and how human beings smell.
  http://faculty.washington.edu/chudler/chsmell.html
  http://kidshealth.org/kid/body/nose_SW.html

**Part 4: This Is It!**

- Students can complete the on-line worksheet, *Environmental Discussion,* as a small group activity to further extend the application of environmental awareness and to develop communication skills.

- Students can complete the home activity Environmental Awareness Contract as a homework assignment that provides an elapsed amount of time before it is due. The final product may be presented in poster format, as an oral report, or as a Power Point presentation.

# 2000-2001 NASA "Why?" Files Series: Program 1

## Segment 1: What's the Stink?

**Program Overview**

Three friends (ages 8 - 10) meet after school in a tree house that belongs to one of the children to watch the TV program, NASA's Kids Science News Network (KSNN). The children learn from the program that a nearby town is being bothered by an unpleasant odor, and viewers are invited to assist with solving the problem of the unknown source of the odor. The three friends decide to try to solve the problem. A neighbor, a retired science professor, assists them with suggestions for informational resources and introduces them to the scientific method. They learn the necessity of identifying the problem, gathering data, forming a hypothesis, testing the hypothesis, controlling the variables, analyzing the data, and reaching a conclusion. To begin their problem solving, the three investigators search for information about smells by using the tree house computer, the Internet, and a web-browser. They visit a NASA Langley electronics engineer to learn about conducting experiments and the role variables play in scientific research.

### National Science Teachers Association (NSTA) Standards

Science as Inquiry

Students develop abilities necessary to do/understand scientific inquiry.

- Observe and ask questions to identify problems.
- Plan and conduct a simple scientific investigation.
- Use tools and equipment to gather data.
- Compare evidence and what is already known.

Science and Technology

Students develop abilities to understand how technological systems work to help solve problems.

- Use technological designs/tools to gather information.

Science in Personal and Social Perspectives

Students understand how the environment affects personal health.

- Be aware that pollution can influence health and the quality of life.

History and Nature of Science

Students understand that science is a human endeavor.

- Recognize that people of all backgrounds engage in various science career activities.

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## National Council of Teachers of Mathematics (NCTM) Standards

Measurement

Students understand systems of measurement and apply a variety to techniques, tools, and formulas for determining measurements.

- Produce simple scale drawings.

Data Analysis, Statistics, and Probability

Students pose questions and collect, organize, and represent data to answer those questions.

- Organize data by using tables and graphs.
- Use graphs to analyze data and to present information to an audience.

Connections

Students recognize, use, and learn about mathematics in contexts outside of mathematics.

- Observe the mathematics and science connections in problem solving and experiments.

Representation

Students create and use representations to organize, record, interpret, and communicate mathematical ideas.

- Use graphs to mathematically represent a written image/response to a question or problem.

## Key Science Vocabulary

**data** - factual information, especially information organized for analysis or used to make decisions

**experts** - persons who are highly skilled or knowledgeable in a certain subject or area

**Internet** - a worldwide information system in which computers are connected so that computer users can communicate and/or obtain information

**scientific method** - an organized way to solve problems

**hypothesis** - an estimate or "educated guess" for solving a problem based on facts, observations,
and available data

**observation** - the act of systematically observing or paying careful attention to something and noting or recording what was observed

**scientist** - a person who has special training and expertise/knowledge in the observation, identification, description, experimental investigation, and explanation of scientific facts or occurrences

**engineer** - a person who has special training and practice in applying scientific principles to the practical design, manufacture, and operation of structures and machines

**variables** - changes which can be controlled by the experimenter when doing an experiment

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## Program Discussion

Before Viewing

1. Ask the students to predict from the title (What's the Stink?) what they think the content of the video program will be. *After the students offer their suggestions as to the video's content, record 5 or 6 of the ideas and have the class vote on the one they feel may be the most accurate prediction. Help the students graph the voting outcome. (The graphing can be done now or later as a class or independent extension activity.)*

2. Have the students name (or brainstorm if they are unfamiliar with the scientific method) the steps of the scientific method. List the suggested steps on the chalkboard or chart. Tell the students that a comparison will be made after they view the video to see if all the steps have been included, if the sequence is correct, or if revisions are needed. *Accept whatever the students suggest prior to viewing the program. After they view the program, give the students an opportunity to revise the list according to the information learned. The revised list should include identifying the problem, asking questions about the problem, observing and gathering data or helpful information, forming a hypothesis, testing the hypothesis, trying again if the data does not support the hypothesis, reaching a reasonable conclusion or explanation, and communicating the results. (Initially, third graders may be able to comply only by naming a specific question to be answered, finding out information about the question, answering the question based on the findings, and presenting the results to others. At the conclusion of the video program series, they should be able to expand the steps.)*

After Viewing

3. Ask the students why Phewsville is an appropriate name for the town with the bad odor. *"Phew" is an expressive sound often used to describe something unpleasant, such as an offensive odor.*

4. Have the students identify the problem the video children will be trying to solve. Have the students explain why this problem needs to be solved. *The problem is, "What is the odor or stink and what is causing it?" The problem needs to be solved because the odor is unpleasant for the residents of Phewsville; it causes air pollution; and it may have an adverse or negative effect on certain people with health conditions such as asthma and other respiratory illnesses.*

5. Ask the students to name the resources and the steps taken by the video investigators thus far in trying to solve the problem of the odor/stink. *The children in the video have identified the problem, begun an informational chart, used the Internet, asked their neighbor for help, and visited an expert (NASA electronics engineer).*

6. Ask the students to name the three basic informational resources suggested by Dr. D. Question the students as to why Dr. D cautioned the video children to "look at everything you read with a critical eye." *The basic resources suggested by Dr. D are books, the Internet (computer), and experts. Anyone can write something for publication or on the Internet without the information being accurate or carefully researched. Therefore, it is best to check several sources to be sure that the facts are correct.*

7. Work with the students to create, on the chalkboard or on a chart, an informational chart similar to the one the children in the video have prepared to help them with the problem. *(You may prefer to give the students the headings and then have them complete the chart as a summary activity.)*

| *What We Know* | *What We Need To Know* | *Where To Go for Help* |
|---|---|---|
| *Health Department has given a warning* | *What's in a smell* | *Dr. D (science expert)* |
| *People in Phewsville smelled something bad* | *How a smell moves* | *Computer/Internet* |
| *No one knows where the smell is coming from* | *How to experiment* | *NASA electronics engineer* |

8. Refer to any recent class experiment; have the students define the term variable and name the variables in that experiment. (Answers will vary.)

9. Explain that the title of the next video in the series is Search for the Stink. Encourage the students to predict what steps they think the video children will take next in trying to solve the problem. *Accept all suggestions; however, to promote the students' logical thinking and problem-solving skills, ask the students to explain why the suggested steps would be helpful.*

## Program Extensions

(NOTE: The extensions can be class or individual enrichment activities and should be selected and/or adapted according to student developmental levels.)

1. **(Language Arts)** Have the students suggest what they think would be a good name for the tree house and write a paragraph to explain why they selected that name.

2. **(Mathematics and Language Arts)** Let the students draw a design, similar to a simple blueprint for a tree house. Ask them to draw the design to scale and label the dimensions. Have them list or write in narrative form how they would furnish a tree house, and what things they would include, if they built a tree house.

3. **(Science and Language Arts)** Direct the students to copy the informational chart (prepared as a class or summary activity) in their science notes so that they can refer to and add data as they work with the subsequent tapes in the series.

4. **(Science, Technology, and Language Arts)** Ask the students to explain (orally or in writing) the experiment that is being conducted by NASA concerning safer landings on airport runways during inclement weather and tell why this experiment is important to air travelers and air transportation. Have the students include a description of how NASA uses computers in the experiment and ask them to identify the four variables in the experiment.

5. **(Science and Language Arts)** Encourage interested students to design and share their own experiments showing how an object moves on both a dry and a wet surface. Have them state their conclusions.

6. **(Science and Language Arts)** Let the students make a list of their favorite smells and a list of their least favorite smells. Allow them to compare lists with partners or in small groups. Additionally, have them choose a favorite and a least favorite smell from their lists and write why they made the particular selections.

7. **(Science, Technology, and Language Arts)** Suggest that the students may wish to search the topic "smells" on the Internet as the video children did to see what other interesting facts can be found. Let the students share some of their findings with the class orally or in writing.

8. **(Science, Technology, and Language Arts)** Have the students use the Internet or available print materials to learn more about snakes and sharks, especially the creatures' sense of smell. Let the students write and/or report orally their findings to the class. Give the students options for further research topics: air pollution; respiratory diseases; the NASA Boeing 757 airplane; and an environmental, aeronautics, or computer scientist or invention.

9. **(Science and Technology)** Encourage the use of the NASA "Why?" Files web site.

# 2000-2001 NASA "Why?" Files Series: Program 1

## Segment 2: Search for the Stink

### Program Overview

The three friends continue their search for the solution to the cause of the curious unknown odor affecting a nearby town and threatening other towns. The children review the scientific method and what they have discovered thus far to help them solve the problem. They make some additions to their informational chart. The three visit a local sanitation department as a possible source of the odor. A scientist there escorts them through the waste water treatment plant, explains the steps in processing sewage and waste water, and shows how the plant uses the scientific method. After the visit, the children decide that the plant is not causing the unpleasant odor. Meanwhile, the latest news report indicates that the odor appears to be lessening in Phewsville. However, the children know that they must continue to pursue the source of the problem in case the odor returns. Looking at a map, they find that there is a chemical plant nearby. The investigators decide to form a hypothesis based on the chemical plant as the possible cause of the bad odor. However, after their friends at school help them organize E-mail responses from the towns' residents and they analyze the data, the three detectives decide to revise their hypothesis and do some more data gathering and experimenting.

### National Science Teachers Association (NSTA) Standards

Science as Inquiry

Students develop abilities necessary to do/to understand scientific inquiry.

- Observe and ask questions to identify problems.
- Plan and conduct a simple scientific investigation.
- Compare evidence with what is already known.

Science and Technology

Students learn how technological systems work to help solve problems.

- Observe technology being used to solve problems and perform tasks.

Science in Personal and Social Perspectives

Students understand how the environment affects personal health.

- Learn how science and technology can improve the quality of health and sanitation.

History and Nature of Science

Students understand that science is a human endeavor.

- Recognize that people from all backgrounds engage in various science career activities.

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## National Council of Teachers of Mathematics (NCTM) Standards

Geometry and Spatial Sense

Students identify characteristics and properties of geometric shapes.

- Visualize, draw, and identify geometric shapes .

Measurement

Students understand attributes, units, and systems of measurement and apply a variety of techniques, tools, and formulas for determining measurement.

- Use appropriate tools of measurement to collect data.

Connections

Students recognize, use, and learn about mathematics in contexts outside of mathematics.

- Observe the mathematics and science connections in problem solving and experiments.

Representation

Students create and use representations to organize, record, interpret, and communicate mathematical ideas.

- Use graphs to mathematically represent a written image/response to question or problem.

## Key Science Vocabulary

**ammonia** - a colorless, pungent or bitterly sharp-tasting or sharp-smelling gas used in manufacturing fertilizers and a wide variety of nitrogen-containing chemicals

**hydrogen sulfide** - a compound of sulfur and hydrogen, which is a colorless, odorless, and highly flammable gaseous element found in most organic compounds

**bacteria** - any of numerous unicellular microorganisms existing in various shapes and associated with processes such as fermentation, putrefaction, and the causation of infectious diseases in plants and animals

**organic materials** - substances derived from living organisms

**pollutants** - impurities or contaminants

**sanitation plant** - a building and equipment that handle the disposal of sewage and garbage for public health purposes

**sewage** - liquid and solid waste carried off in sewers and drains

**aeration basin** - an artificially enclosed area of water that charges substances with a gas and/or exposes them to fresh air for purification

**meter** - a device used to measure, indicate, record, or regulate

**odorous substances** - materials that can be perceived by a sense of smell

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## Program Discussion

Before Viewing

1. Help the students summarize briefly what took place in the first program (What's the Stink?). *Three friends meet after school to watch the TV program, NASA's Kids Science News Network (KSNN). They learn that a town is being bothered by an unpleasant odor, and viewers are invited to help locate the odor's unknown source. The three friends decide to try to solve the problem. To begin their investigation, the children prepare an informational chart to determine what they know, what they need to know, and where to go for help. A neighbor, a retired science professor, gives them suggestions for informational resources and introduces them to the scientific method. They search for information about smells by using a computer, the Internet, and a web-browser; then, they visit a NASA Langley electronics engineer to learn about conducting experiments and the role of variables.*

2. Review with the students the informational chart prepared as an extension after viewing the first segment, "What's the Stink?". (see page 5)

3. If available, use the chart prepared after viewing the first program to review the steps of the scientific method. (Remember to adapt the steps, if necessary, for third graders.) *The chart will include identifying the problem or question to be answered, asking questions about the problem, observing and gathering data or helpful information, forming a hypothesis, testing the hypothesis, trying again if the data does not support the hypothesis, reaching a reasonable conclusion or explanation, and communicating the results to others.*

4. Ask the students to predict what they think the children in the video will do next. *Accept all responses, as long as the students can support their predictions with logical reasons.*

After Viewing

5. Ask the students why the children in the video used a map in their investigation. *The children located Phewsville and the adjoining towns on the map. They were especially interested in how close their town was to Phewsville. They didn't know where the odor was coming from or when the bad smell might return and spread to their town and the surrounding towns. Examining things shown on the map might give them a clue.*

6. Have the students explain why the children in the video went to the waste water treatment plant at the sanitation department. *Because the sanitation department and the waste water treatment plant handled sewage and garbage, the children thought they might be the source of the unpleasant odor.*

7. Ask the students if the sanitation department and the waste water treatment plant proved to be the source of the bad odor. Ask them to explain their response. *The department and plant were not the source of the bad odor because after the process was completed, the remaining water was clean and had no unpleasant odor. If an odor had remained, the process and the steps of the scientific method would have been repeated until the problem was resolved.*

8. Have the students relate the latest news about the mystery odor as reported by KSNN. *KSNN reported that the stink in Phewsville appeared to be gone and that no one had reported getting sick from it.*

9. Have the students explain why the children in the video are not giving up on trying to solve the problem, although the stink is no longer apparent in Phewsville. *The problem of what the stink was and what caused it has not been solved. Therefore, the bad smell might return to Phewsville or to other nearby towns unless the cause of the odor is found and a reoccurrence can be prevented.*

**10.** Have the students explain the process the children in the video and their school friends used to organize the E-mail responses they had received from the residents of the nearby towns with information about the unpleasant odor. *The children in the video and their friends separated the responses by towns and then by days. This separation told them who smelled the odor and when. They next used colored pins on the map to show the data visually.*

## Program Extensions

(NOTE: The extensions can be class or individual enrichment activities and should be selected and/or adapted according to student developmental levels.)

**1. (Mathematics and Geography)** Use a state map so the students can locate their town or city and then find/name the nearest towns or cities. Have them use the map legend to estimate the distance from their town to some of the other locations. Use a local map so the students can locate their school and the next nearest school, fire department, post office, mall, or other locations of interest.

**2. (Mathematics and Geography)** Tell the students to imagine and then draw their own maps showing the location of Phewsville, Exville, Mid City, and Big City. (The children in the tape live in Big City.) Remind the students to devise a simple scale to indicate the distance between the towns.

**3. (Mathematics and Language Arts)** Ask the students to use their maps to draw a straight line connecting the towns and creating a geometric shape. Ask them to write a sentence or short paragraph naming the geometric shape most nearly like the one they made. Direct them to write why they selected the particular geometric figure.

**4. (Science, Mathematics, and Language Arts)** Ask the students to think of the different kinds of meters that might be used in the school or around their homes. Have them make a chart with three columns showing (1) the name of the meter; (2) what the meter measures or records; and (3) the unit of measure the meter uses.

*Examples:*

| *Name of Meter* | *What It Measures or Records* | *Unit of Measure* |
|---|---|---|
| *Electric meter* | *Electricity* | *Kilowatts* |
| *Thermometer* | *Temperature* | *Degrees* |
| *Speedometer* | *Speed* | *Miles per hour* |

**5. (Science and Language Arts)** Ask the students to draw and label a diagram (similar to a flowchart) or to write a description of the process used by the waste water treatment plant from the time waste comes into the plant to the conclusion of the process.

**6. (Science and Language Arts)** Have the students write a paper explaining why the work of the sanitation department and the waste water treatment plant are so essential to public health and the quality of life.

**7. (Science, Technology, and Language Arts)** Let the students use the Internet or available print materials to learn more about ammonia and hydrogen sulfide and some of the products that contain these gaseous elements. Have the students share their findings orally or in writing.

Give the students options for further research topics: water pollution, the necessity of water for good health, the usefulness of "good" bacteria, and a particular kind of meter.

**8. (Science and Technology)** Encourage the use of the NASA "Why?" Files web site.

## Segment 3: We're Almost There

### Program Overview

Bianca, Jacob, and Matthew, the investigative team, continue to search for the cause of the strange, unpleasant odor that is bothering the residents of several towns. They continue to collect and analyze data, experiment, test their hypotheses, and consult with experts. They visit a doctor specializing in treating the nose (an otolaryngologist) and a museum curator who helps them learn about a shark's sense of smell. After getting advice from their neighbor, Dr. D, a retired science professor, the children in the video perform additional experiments about how smells move. They elicit the help of their classmates and pay more attention to controlling the variables. Meanwhile, the latest KSNN news update reports that the stink is definitely being smelled in Big City, the children's town. The children suspect that the wind may be a variable that is playing a role in the movement of the odor, and they plan another experiment to test their idea. While they are getting closer to solving the problem, they are not there yet!

### National Science Teachers Association (NSTA) Standards

Unifying Concepts and Processes

Students develop an understanding that evidence consists of observations and data on which to base scientific explanations.

- Use observations, measurement tools, and experiments to gather information for basing explanations about investigations.

Science as Inquiry

Students develop abilities necessary to do/to understand scientific inquiry.

- Observe and ask questions to identify problems.
- Plan and conduct a simple scientific investigation.
- Employ simple equipment and tools to gather data.
- Use the data to construct a reasonable explanation.

Life Science

Students develop an understanding of the characteristics of organisms and their environment.

- Observe that organisms' patterns of behavior are related to their environment and their need for survival.

Science and Technology

Students develop abilities to understand how technological systems work to help solve problems.

- Use technological designs/tools to gather information.

Science in Personal and Social Perspectives

Students develop an understanding of personal health.

- Learn how the nose functions in the process of smelling and how behaviors and substances, such as tobacco, can affect the sense of smell.

History and Nature of Science

Students understand that science is a human endeavor.

- Recognize that people of all backgrounds engage in various science career activities.



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## National Council of Teachers of Mathematics (NCTM) Standards

Patterns, Functions, and Algebra
Students understand various types of patterns and functional relationships.
• Identify and represent how a change in one variable relates to the change in a second variable.

Measurement
Students understand attributes, units, and systems of measurement.
• Use appropriate tools of measurement to collect data.

Data Analysis, Statistics, and Probability
Students pose questions and collect, organize, and interpret data to answer those questions.
• Collect data using observations, measurement, and experiments.

Connections
Students recognize, use, and learn about mathematics in contexts outside of mathematics.
• Observe the mathematics and science connections in problem solving and experiments.

Representation
Students emphasize mathematical representations to foster understandings.
• Create and use representations to organize, record, and communicate mathematical ideas.

## Key Science Vocabulary

**chemical** - a substance related to or produced by chemistry (the science of the composition, structure, properties, and reactions of matter) or a chemical process

**chemical compounds** - substances made up of a combination of two or more chemicals

**molecule** - a tiny bit; the smallest particle an element or compound can be divided into without changing its chemical or physical properties

**receptors** - specialized cells or groups of nerve endings that are especially sensitive to an alteration of some environmental factor and that respond to sensory stimuli or actions

**olfactory chemoreceptors** - sense of smell organs that respond to a chemical stimulus

**curator** - a person in charge of a collection such as at a museum or art gallery

**stopwatch** - a watch that can be stopped and started instantly to measure an exact duration

**predictable** - likely to happen, expected, known in advance

**sampling** - taking a sample or a small portion, especially for examination or testing; the small portion taken

**meter stick** - a tool or instrument for measuring, indicating, regulating, or recording a unit of measurement



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## Program Discussion

Before Viewing

1. Review the meaning of the terms hypothesis and variable. *A hypothesis is an estimate or "educated guess" for solving a problem based on facts, observations, and available data. A variable is a change which can be controlled by the experimenter when doing an experiment or scientific investigation.*

2. Have the students summarize briefly what they remember about what Dr. Schechter told them about smell and how noses work. *(Answers will vary.) Smells are made up of molecules (small invisible pieces that drift in the air). The molecules enter the nose through the nostrils and reach the nose cavity where nerve endings pick up the smells. The brain identifies the smell because of its number and kind of molecules and its location in the nose cavity. It is difficult to tell whether people identify the smells exactly the same. Individuals may have other smell molecules filling their nasal cavities that may affect what and how they smell.*

3. Ask the students to compare a shark's sense of smell to a human being's. *The shark has a keener sense of smell because its sense of smell is necessary for its survival as a predator. The shark's nose is specifically designed to contain more sensory cells. Its nose is larger and longer.*

4. Have the students explain why and how the children in the video conducted the tree house experiment with the air spray and what conclusion they reached. *The children needed to know how smells travel. Two of them stood in a circle with eyes closed, the third sprayed some air spray, and the two experimenters used a stopwatch to measure the time it took before they smelled the spray odor. (Point out to the students that the children participating in the experiment kept their eyes closed, and the spray was not directed towards them.) They decided that two of them have similar noses and that the smell traveled at the same rate of speed. However, since the E-mail data did not support these findings for the residents of the towns experiencing the mysterious odor, the children concluded that they needed to revise their hypothesis and do some more experimenting.*

5. Ask the students to recall the problems Dr. D pointed out to the video children about the way the tree house smell experiment was conducted. *They were not careful with controlling the details. They did not measure to be sure that the participants were standing an equal distance apart, they did not check to see if there were any distracting smells in the tree house, and the sampling was too small.*

6. Ask the students to explain why an adequate sampling is needed for all experiments. *The sampling needs to be large enough to ensure that the results are probable and that the results are not reached just by chance. If the same results are found in a large number of situations, the chances are better that the results are reliable or probable.*

7. Have the students describe how the children in the video conducted the first smell experiment in their classroom. Structure the description by asking them to tell why the classroom students were divided into two groups and what efforts were taken to control the variables for the test conditions.
*The class was divided into two groups, with each group having a specific task to help ensure that the experiment was conducted exactly the same for each participant. The two groups were "the sniffers" and the timers and recorders. The sniffers stood in a circle exactly two meters from the sprayer and one meter apart, they raised their hands when they smelled the spray, and the timers/recorders used a stopwatch to note and record the times. The children shut the windows and turned off the fans and the air conditioning. They measured the distances carefully, used stopwatches for time accuracy, and controlled the air flow.*

**8.** Have the students explain the results of the first experiment. Be sure to ask them why Dr. D suggested that the video children discard the numbers that deviated sharply from the others or were extremely high or low. *The numbers for the smell times were different because there were still some variations that existed, such as George's cold. Also, some students took deep breaths, and some took little sniffs. However, except for a few extremes, the numbers were clustered or relatively close.Dr. D explained to the children that since there were only a few numbers that deviated greatly from the others, these could have been mistakes in measuring or recording. He advised them to discard these extremes because they could be misleading when the results were analyzed.*

**9.** Ask the students to explain the latest KSNN report. Ask them what was in the report that intrigued Bianca. *The residents in Big City were now smelling something very unpleasant. The mysterious smell seemed to be moving in a different direction, and the westerly wind was not helping the situation.*

**10.** Ask the students why the children in the video returned to their classroom to conduct other experiments and how these experiments were different. *Since the results might have been influenced by the variations in the first experiment and to test the idea that the wind could be influencing the smell's movement, the children in the video decided to try another experiment. This time they used a fan to imitate the wind. Some of the sniffers stood in front of the fan, some in back of the fan, and some to the side of the fan. The experiment was repeated several times.*

**11.** Have the students report the results of the experiments with the fan. Ask them what they think the implications of the results are. *It took longer for the sniffers standing in the back and to the side of the fan to smell the spray. This result occurred each time the experiment was repeated.*

*Accept any of the responses for which the students can give logical explanations. Try to lead the students to surmise that if the wind acts in a similar way to the fan, it may affect the direction in which the unpleasant odor travels so that different towns' residents may smell the odor at different times, depending on the direction of the wind.*

**12.** Review with the students the remaining possible sources of the stink, according to the map and the known data: chemical plant, trash burning plant, paper mill, and "unknown." Have each student write his/her hypothesis on a post-it note. Appoint a small committee to organize the post-it responses in columns on the chalkboard or a chart. Have the committee tally and/or graph the responses for future comparison with the problem's solution (Program 4). *Keep the tally or graph so that the students can see how their responses compared with the final problem solution.*

## Program Extensions

(NOTE: The extensions can be class or individual enrichment activities and should be selected and/or adapted according to student developmental levels.)

**1. (Science, Mathematics, and Language Arts)** Duplicate the smell experiment with the students. Have the students to do as much of the planning and conducting of the experiment as appropriate. Ask them to make a drawing or diagram representing the experiment. Guide the students to make every effort to control the variables. Caution them to take safety precautions: (1) have the sniffers use goggles or blindfolds, or keep their eyes closed; and (2) direct the spray up and away from the sniffers rather than toward them. Repeat the experiment several times to make sure that the results are similar. (NOTE: Be sure to wait a sufficient time between experiments so that the spray smell will not still be present and distort the results.)

Have the students report their findings orally and/or in writing and tell what connections they think the results may have to the cause of the mysterious odor.



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**2. (Science and Mathematics)** Have the students use the numbers obtained in their class smell experiment activities to find the average time for those participants who were standing in front of the fan, those standing behind the fan, and those standing beside the fan. Have them calculate the class average.

**3. (Mathematics)** Have the students plot the numbers of the class experiment results on a grid or bar graph for the participants in each of the three locations.

**4. (Science and Mathematics)** Encourage the students to design a different experiment to test how smell moves. Suggest that they draw a diagram representing the directions for the experiment and write the directions. If possible, let them conduct the experiment for the class. (NOTE: Caution the students to be aware of safety measures for their eyes and noses when using any substances as sources of the odors.)

**5. (Science and Health)** Direct the students to find the name of the medical specialty of a doctor who treats ear, nose, and throat conditions. Ask them to tell what resource they used to find the answer.

**6. (Science, Health, Language Arts, and Art)** Have the students write a paragraph describing how smoking negatively affects the sense of smell. Suggest that they also may want to draw a poster based on their findings, encouraging people not to smoke.

**7. (Science and Language Arts)** Ask the students to name places other than museums that might have a curator.

**8. (Mathematics)** Have the students estimate the measurements of objects within the classroom and then use appropriate measuring devices to record the actual measures in metric and U.S. Customary units.

**9. (Science, Mathematics, Technology, and Language Arts)** Direct the students to use the Internet and/or available print materials to find and list predators other than sharks that depend on a keen sense of smell to track and trap their prey. Suggest that they prepare a chart with drawings of the predators and a scale showing the size relationship of the predators. Ask them to be prepared to share their findings with the class, including why certain predators need large or long noses.

**10. (Science and Language Arts)** Ask the students to write a paragraph or paper telling why scientists' work is difficult and sometimes very discouraging.

**11. (Science, Technology, and Language Arts)** Suggest that the students use the Internet or available print materials to learn about a scientist who had to repeat his/her experiments several times and to persevere under adverse conditions before being successful. Let the students share their findings orally and/or in writing.

**12. (Science and Technology)** Encourage the students to use the NASA "Why?" Files web site.

## Segment 4: This is it!

### Program Overview

The three "smell detectives" are getting very close to solving the problem of the mysterious smell. They determine that wind is definitely a factor, and they visit a weatherman (meteorologist) to find out more about the wind and the wind direction on each of the days when the towns noticed the bad odor. Dr. D suggests that they create a matrix to organize their data. The video children visit a NASA atmospheric science researcher to learn if wind can move smells long distances. The researcher describes some NASA atmospheric experiments proving that smelly gases can travel between continents and oceans. The tree house detectives, however, are still confused. The evidence points to some source near Exville, but the map does not indicate a facility there which could be a possible cause of the bad odor. Dr. D and the children visit Exville. Much to their surprise, the stink's source seems to be the new candy factory. After returning to his lab, Dr. D performs an experiment to demonstrate that unpleasant-smelling chemicals can produce sweet-tasting substances. The mystery is solved; the candy factory is the cause of the stink! Television station KSNN features the children telling how they used the scientific method to find the solution to the problem.

To close the program series, Dr. D makes some summary comments about the scientific method and safety measures when doing experiments.

### National Science Teachers Association (NSTA) Standards

Unifying Concepts and Processes

Students develop an understanding that evidence consists of observations and data on which to base scientific explanations.

- Use observations, measurement tools, and experiments to gather information for basing explanations about investigations.

Science as Inquiry

Students develop abilities necessary to do/to understand scientific inquiry.

- Observe and ask questions to identify problems.
- Employ simple equipment and tools to gather data.
- Use the data to construct a reasonable explanation.

Earth and Space Science

Students understand certain concepts about weather and how weather can be described by measurable quantities.

- Observe changes and patterns in wind direction.
- Learn about instruments used in gathering weather data.

Science and Technology

Students develop abilities to understand how technological systems work to help solve problems.

- Use technological designs/tools to gather information.

History and Nature of Science

Students understand that science is a human endeavor.

- Recognize that people of all backgrounds engage in various science career activities.



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## National Council of Teachers of Mathematics (NCTM) Standards

Number and Operations

Students understand numbers and operations.

- Use computational tools and strategies fluently and estimate appropriately.

Patterns, Functions, and Algebra

Students understand and use various types of patterns, functions, symbols, and models.

- Represent and record patterns using tools such as tables and graphs.
- Understand the concept of variables and use variables to solve problems.

Measurement

Students understand attributes, units, and systems of measurement.

- Use appropriate techniques and tools for determining measurement.

Data Analysis, Statistics, and Probability

Students pose questions and collect, organize, and represent data to answer those questions

- Organize data by using tables and graphs.
- Use graphs and tables to analyze data and present information to an audience.

Connections

Students recognize, use, and learn about mathematics in contexts outside of mathematics.

- Observe the mathematics and science connections in problem solving and experiments.

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## Key Science Vocabulary

**matrix** - a rectangular arrangement of elements in rows and columns

**meteorologist** - a scientist that deals with the science of the atmosphere, especially with weather and weather forecasting

**atmosphere** - the mass of air surrounding the Earth

**anemometer** - an instrument for measuring wind force and velocity (speed)

**clockwise** - in the same direction as the rotating hands of a clock

**counterclockwise** - in a direction opposite to the rotating hands of a clock

**satellite** - a celestial body orbiting another of larger size; a secondary planet; or a man-made object or vehicle intended to orbit the Earth, the Moon, or another celestial body and usually instrumented for the transmission of space data

**kilometer** - a metric unit of length (1.61 kilometers = 1 mile)

**molecule** - a unit of matter that is the smallest particle into which an element or compound can be divided without changing its chemical and physical properties
(NOTE: Wait until after the students have viewed Program 4 to discuss the remaining key science vocabulary, because the words and their meanings will "give away" the solution to the problem of the unpleasant odor source.)

**butyric acid** - an acid found especially in butter in the form of glycerides; in rancid butter, the free acid obtained as a colorless liquid of unpleasant odor; used chiefly in making esters (flavoring materials) or in cellulose for plastics

**ethyl alcohol** - ordinary alcohol, often referred to as "household" or "rubbing" alcohol

**sulfuric acid** - an acid produced from sulfur oxide; a highly corrosive, dense, oily liquid used to manufacture a wide variety of chemicals and materials

## Program Discussion

Before Viewing

1. Have the students explain why safety measures are important in conducting all experiments. Ask the students to suggest some safety precautions for performing experiments. Have them tell how the children in the video protected their classmates' eyes and noses during the classroom smell experiments. *The students should discuss that the safety of the experimenters must always be considered in planning and conducting experiments. Safety measures should include protecting all body parts from possible injury when using objects, tools, and substances. Encourage the students to suggest some general precautions such as wearing goggles, gloves, lab aprons, or coats; reading the labels on all substances to be used; keeping a water supply close by; and working under the supervision of an adult.*

*The children in the video used an "everyday" room spray that did not contain dangerous substances. The spray was never pointed directly at the participants. The sniffers kept their eyes closed, and none of the participants stood close to the sprayer. Although the action was not shown in the video, the teacher had checked to make sure that any students with allergies or respiratory problems were excluded from the experiment.*

2. Ask the students to explain the pattern that the children in the video kept noticing when they analyzed the results of the classroom smell experiments. Have them tell how the pattern might be related to the reports from the towns smelling the unpleasant odor. *It always took longer for the students standing behind and beside the fan to smell the spray than for those standing in front of the fan.*

*If the wind was moving the bad smell, those towns directly in front of the wind's direction on a particular day would smell the odor faster and stronger than those towns located behind or beside the direction of the wind.*

3. Have the students think back to Program 3 and predict what experts the children in the video will visit next. *The children in the video will visit a weatherman (meteorologist) and a NASA atmospheric science researcher.*

After Viewing

1. Let the students react to the solution of the problem and the predictions they made on the post-it notes activity for Program 3. *The students will have various comments about how the candy factory was the cause of the bad odor and why they had predicted one of the other places or "unknown" as the source of the stink. They may want to share their favorite parts of the program series, their favorite characters, humorous incidents, what they learned, and so forth.*

2. Ask the students to explain why/how the candy factory was the cause of the stink. *The chemicals used in making the candy had unpleasant odors until they were mixed and processed to produce the candy. The bad smells of the chemicals were escaping or being emitted into the air before they were processed. Now that they are alerted to the situation, the factory owners and managers promise to take steps to eliminate this problem.*

3. Have the students explain why the children in the video had not considered the candy factory in any of their hypotheses. *The candy factory was so new that it was not on the map the children in the video were using. Also, the children might not have suspected the candy factory because they may have thought that something as pleasant-tasting as candy would not be made from something that smelled so unpleasant.*

4. Ask the students how the information provided by the weatherman was useful to the three investigators in solving the stink problem. *The weatherman confirmed that the wind does affect the movement of smells. He gave the children weather maps which showed the direction of the wind on each of the days that the towns' residents had been smelling the unpleasant odor. By using the wind direction data, the E-mail information, and the area map, the children were able to get an idea of where the stink was originating.*

5. Have the students explain what a weatherperson (meteorologist) does and some of the weather prediction tools that the meteorologist in the video showed the tree house detectives. *A meteorologist studies the atmosphere, especially weather. He/she knows how to use data such as temperature, air pressure, and wind direction to help predict weather conditions.*

*The meteorologist in the video showed the children an anemometer, a wind vane, weather maps, and a computer.*

6. Ask the students why it is important to know about the day's weather and the prediction of the weather for several days. *Accept all responses for which the students can give logical explanations. They will probably suggest things such as knowing the most appropriate clothes to wear, what outdoor activities to plan, whether it would be a good time to travel, whether to leave pets outside for the day, how to prepare for any special weather conditions (e.g., ice or snowstorm, hurricane, and so forth).*

**7.** Ask the students how they might prove that the wind changes directions. *Accept all responses for which the students can give logical explanations. They will probably suggest listening to radio or television weather reports, reading newspaper weather reports, observing wind socks on their home decks, or watching weather vanes on their roofs and then recording or charting the wind directions for several days.*

**8.** Have the students describe and sketch on the chalkboard the matrix that Dr. D suggested the children in the video design to organize the information they had collected. *The matrix was a chart with columns in which the days of the week were written across the top and the names of the towns were listed along the left side. "X" symbols were used to designate the wind direction for each location on each day of the week.*

**9.** Ask the students to summarize some of the information provided to the children in the video by the NASA atmospheric science researcher. *Tracking gases in the atmosphere is part of NASA's atmospheric science research. The researchers use special equipment and instruments on planes and satellites. One experiment involved tracking smoke molecules from fires in South America and Africa for hundreds of kilometers or miles. The pollution traveled over much of the world. The pollution molecules will eventually react with other gases in the atmosphere to become other molecules that will be dissolved in rainwater and released from the atmosphere when it rains.*

**10.** Assist the students with bringing their information chart up-to-date. Ask them what they observe about the chart now.

*(Only the additions are shown.)*

| *What We Know* | *What We Need To Know* | *Where To Go for Help* |
|---|---|---|
| *Wind moves smell* | | *Weatherperson (meteorologist)* |
| *Who smelled the odor on each day* | | *NASA atmospheric science researcher* |
| *What generates wind* | | |
| *Wind can change direction* | | |
| *Wind direction for each day* | | |

*The students should observe that the "need to know" items have become "what we know" items.*

**11.** Have the students summarize the steps of the scientific method that the tree house investigators used to discover what caused the stink. *The children in the video identified the problem (What is the source or cause of the stink?) and asked questions about the problem. They determined what they already knew, what they needed to know, and where to go for additional information or help. They formed several different hypotheses; collected, organized, and analyzed their data; experimented; and changed their hypotheses when the data did not support their predictions. The children used observation, books, the Internet, E-mail, and experts to gather their information. They eventually solved the problem by analyzing all of their data and finding the hypothesis that was supported by the data (the candy factory is the source of the odor).*

**12.** List the responses on the chalkboard when you ask the students to name the various technology used in the program series to provide the information which helped solve the problem. (The important instructional concept is for the students to understand that the term technology refers to methods, materials, and tools used in the application of science. They are not expected to name all of the specific technologies in the series.) *The students will probably name things such as these: computer, Internet, E-mail, television, books, experts, map, telephone, waste water treatment plant equipment (meter, aeration basin, scrubber), receptor, stopwatch, fan, aquarium or shark tank, bar graph, matrix, anemometer, wind vane, weather map, satellite, airplane, and chemicals.*

13. Explain to the students that the term "variable" can be used in mathematics as well as science. *Discuss how the terms are used to mean different things; for example "variable" in science means something that can be controlled by the experimenter, while "variable" in mathematics can be a letter or symbol used to stand for an unknown number in equations.*

*If your mathematics curriculum includes equations with variables, teach or review a lesson on equations with variables and provide practice for the students in solving the equations.*

14. Have the students identify a problem that the class can try to solve by using the scientific method. Work with them to seek the solution to the problem. Remind them that the scientific method can be used for any problem they may encounter in everyday life.

15. Consider introducing a weather unit at this time or correlating an ongoing weather unit with the video program.

## Enrichment

(NOTE: The extensions can be class or individual enrichment activities and should be selected and/or adapted according to student developmental levels.)

1. **(Science, Technology, and Mathematics)** Ask the students to watch one of their local radio or television news programs or use a daily newspaper to chart the weather conditions for a week or longer. Suggest that they record the wind direction; the high and low temperatures; and whether there was sunshine, cloudiness, and/or precipitation. Some students may wish to make this a monthly project.

2. **(Science, Technology, and Language Arts)** Have interested students use the Internet or available print materials for directions to construct a wind vane or gauge and demonstrate it to the class. Suggest that they use their vane/gauge to determine and chart the wind direction for a given period. Let them share their findings with the class orally and by displaying their vane/gauge and chart.

3. **(Science, Technology, and Language Arts)** Ask interested students to use the Internet or available print materials to learn more about meteorology as a career. Have them write a paper telling about the job tasks, training requirements, and special skills needed to be a meteorologist. Have them include why they would or would not like to be a meteorologist.

4. **(Science and Language Arts)** Have the students select an occupation (other than meteorologist) that they feel is dependent on the weather and write a paragraph explaining why they believe the occupation is affected by the weather. They may include an occupation such as a construction worker, bus driver, pilot, landscaper, farmer, or professional skier.

5. **(Science and Mathematics)** Have the students suggest data that could be recorded on a matrix and have them design a matrix of their own and record data of their choice. For example, they might chart (1) their test grades for a week, (2) the height and/or weight of their friends, or (3) the number of points scored by their favorite professional basketball player in a certain number of games.

6. **(Science and Language Arts)** Discuss with the students whether they think it is important to study and track world pollution and tell why or why not.

**7. (Science, Technology, Language Arts, and Art)** Have the students use the Internet or other available print materials to write a paper about the particular kind of pollution that most concerns them; why they are concerned; and what, if anything, is being done to improve the pollution problem. Suggest that they draw a poster asking people to help reduce or eliminate that particular kind of pollution.

**8. (Mathematics and Geography)** Have the students locate the continents of South America and Africa on a globe or map. Ask the students to use the map scale, if one is available, to estimate the distance from South America to their location in the United States and from Africa to their location in the United States.

Have the students convert the estimated distances from miles to kilometers (miles x 1.61). For additional practice, give the students some other distances (in statute miles) to convert to kilometers and/or from kilometers to miles (kilometers x 0.62).

**9. (Mathematics and Language Arts)** Have small groups of students work together as researchers to conduct a survey among their friends, neighbors, or family to find the farthest distance that the people surveyed have traveled from home to another destination on a one-way trip. Direct the students to chart or graph their results and report the findings to the class orally.

**10. (Science, Mathematics, and Language Arts)** Remind the students that they "met" a number of experts in the program series (science professor, NASA electronics engineer, NASA atmospheric science researcher, otolaryngologist, meteorologist, waste water treatment plant scientist, and museum curator). Ask the students to select one of the experts and write a paper telling why that particular expert needed science and mathematics courses in school when he/she was preparing for his/her career. Include how the expert uses both science and mathematics in performing his/her job.

**11. (Science and Language Arts)** Let the students choose their favorite character in the program series and write a paragraph telling why they picked the particular character and how that character contributed to solving the stink problem.

**12. (Science and Technology)** Encourage the use of the NASA "Why?" Files web site.

# The Case of the Unknown Stink
## National Standards

| National Science Education Standards | National Educational Technology Standards | National Mathematics Standards | National Geography Standards |
|---|---|---|---|
| The student will develop abilities necessary to do scientific inquiry. | The student will understand and use basic operations and concepts of technology. | The student will apply a variety of techniques, tools, and formulas for determining measurement. | The student will understand how to use maps and other geographical representations, tools, and technologies to acquire, process, and report information from a spatial perspective. |
| The student will develop an understanding about scientific inquiry. | The student will use technology tools productively. | The student will pose questions and collect, organize, and represent data to answer those questions. | The student will understand how to analyze the spatial organization of people, places, and environments on Earth's surface. |
| The student will develop an understanding of personal health. | The student will use technology as a communication tool. | The student will interpret data using methods of exploratory data analysis. | |
| The student will develop an understanding of changes in the Earth and sky. | The student will use technology as a research tool. | The students will organize and consolidate student mathematical thinking to communicate with others. | |
| The student will develop an understanding about science and technology. | The student will use technology resources in problem solving and decision making. | The student will recognize, use, and learn about mathematics in contexts outside mathematics. | |
| The student will develop an understanding of changes in the environment. | | The student will create and use representations to organize, record, and communicate mathematical ideas. | |
| The student will develop an understanding of science as a human endeavor. | | | |



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# The Case
## Related Children's Literature

Kramer, Stephen P.:
*How to Think Like a Scientist: Answering Questions by the Scientific Method.*
Thomas Y. Crowell, (1997). ISBN 0690045654

Carey, Stephen S.: *A Beginner's Guide to Scientific Method.* International Thomson Publishing, (1997). ISBN 0534528430

Kneidel, Sally S.: *Creepy Crawlies and the Scientific Method: More Than 100 Hands-On Science Experiments for Children.* Fulcrum Publishing, (1993). ISBN 155511188

Sprung, Barbara and Patricia B. Campbell, and Merle Froschi: *What Will Happen If...- Young Children and the Scientific Method.* Educational Equity Concepts Incorporated, (1985). ISBN 0931629020

Parker, Steve: *Shocking, Slimy, Stinky, Shiny Science Experiments.* Sterling Publishing Company Inc., New York, (1998). ISBN 080696295X

Markle, Sandra: *Measuring Up!: Experiments, Puzzles, and Games Exploring Measurement.* Atheneum, (1995) ISBN 0689319045

Levine, Shar and Leslie Johnstone: *The Microscope Book.* Sterling Publishing Company, New York, (1996). ISBN 0806948981

Hickman, Pamela: *Animal Senses: How Animals See, Hear, Taste, Smell and Feel.* Kids Can Press, (1998). ISBN 1550744232

# NASA Resources for Educators

NASA's Education Home Page (http://education.nasa.gov) serves as the cyber-gateway to information regarding educational programs and services offered by NASA for educators and students across the United States, and provides specific details and points of contact for all of NASA's educational efforts and Field Center Offices. Those utilizing the site will have access to a comprehensive overview of NASA's educational programs and services, as well as home pages offered by NASA's four areas of research and development

NASA Langley Research Center, Office of Education (http://edu.larc.nasa.gov) offers a wide variety of opportunities for educators at all levels of instruction. The Office of Education seeks to enhance the teaching of mathematics, science, and technology through its distance learning programs, all of which are described on the web site. Educators can also search NASA educational resources for the classroom including activities, curriculum enhancing projects, and equipment. From this site, you can link to our NASA "Why?" Files web site.

NASA Spacelink (http://spacelink.nasa.gov) is one of NASA's electronic resources that is specifically developed for use by the education community. This comprehensive electronic library offers teacher guides, wall sheets, listings of videos, computer software, and other materials that have been developed to meet national education standards. Educators can search specific curriculum materials by grade level and subject matter. Current and historical information related to NASA's aeronautic and space research can be found on Spacelink. Links to NASA Educator Resource Centers (ERCs), the Central Operations of Resources for Educators (CORE), news releases, current state reports on agency projects and events, and television broadcast schedules for NASA Television are also provided.

Quest (http://quest.nasa.gov) is the home of NASA's K-12 Internet initiative. This electronic resource specializes in providing programs, materials, and opportunities for teachers and students to use NASA resources as learning tools to explore the Internet. One of its unique projects is Sharing NASA, a series about on-line, interactive units where students can communicate with NASA scientists and researchers to experience the excitement of real science in real time. The Learning Technologies Channel (LTC) (http://quest.nasa.gov/ltc/) is a NASA location on the Internet that allows you to participate in on-line courses and to remotely attend some NASA workshops and seminars. A primary focus of the LTC is to broaden the uses of the Internet to include in-service teacher training and to bring new Internet experiences into the classroom.

NASA CORE, Central Operation of Resources for Educators (http://core.nasa.gov) is a worldwide distribution center for NASA multimedia educational materials. Educational materials include videotape programs, slide sets, and computer software. For a minimal fee, NASA CORE will provide educators with materials through its mail order service. A free NASA CORE catalog is available.

NASA CORE
15181 State Route 58 South, Oberlin, OH 44074,
phone: (440) 775-1400, fax: (440) 775-1460, E-mail: nasaco@leeca.org

The NASA Educator Resource Centers' Network (http://education.nasa.gov/ercn) is composed of Educator Resource Centers located at or near all NASA installations. ERCs are located at planetariums, universities, museums, and other nonprofit organizations nationwide. These centers supply instructional activities, videotapes, slides, and computer software generated by NASA programs, technologies, and discoveries. These materials are designed for educators of all disciplines and are aligned to the national education standards.

For more information on NASA education programs and aeronautics-related materials, educators may contact the ERC at the following NASA Centers. The NASA field centers that have leading roles and responsibilities in Aero-Space Technology (A-ST) research are in boldface.



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AK, Northern CA (southern-most counties of Inyo, Kings Monterey, Tulare), HI, ID, MT, NV, OR, UT, WA, WY
**NASA Ames Educator Resource Center**
Mail Stop 253-2
Moffett Field, CA 94035-1000
(650) 604-3574
http://ccf.arc.nasa.gov/dx/basket/trc/trchome.html

AZ, Southern CA (northern-most counties of Kern, San Bernadino, San Luis Obispo)
**NASA Dryden Educator Resource Center**
45108 North Third Street East
Lancaster, CA 93535
(661) 948-7347
http://www.dfrc.nasa.gov/trc/ERC

CA
NASA JPL Educator Resource Center
Village at Indian Hills Mall
1460 East Holt Blvd., Suite 20
Pomona, CA 91767
(909) 397-4420
http://eis.jpl.nasa.gov/eao/

CT, DE, DC, ME, MD, MA, NH, NJ, NY, PA, RI, VT
NASA Goddard Educator Resource Center
Mail Code 130.3
Greenbelt, MD 20771
(301) 286-8570
http://pao.gsfc.nasa.gov/gsfc/educ/trl/welcome.html

VA's and MD's Eastern Shore
NASA Wallops Educator Resource Center
Education Complex - Visitor Center
Building J-17
Wallops Island, VA 23337
(757) 824-2298

FL, GA, Puerto Rico, Virgin Islands
NASA Kennedy Educator Resource Center
Mail Code ERC
J.F. Kennedy Space Center, FL 32899
(407) 867-4090

CO, KS, NE, NM, ND, OK, SD, TX
Johnson Space Center
1601 NASA Road One
Houston, TX 77058
(281) 244-2129
http://www.jsc.nasa.gov

KY, NC, SC, VA, WV
**NASA Langley Educator Resource Center**
Virginia Air and Space Center
600 Settlers Landing Road
Hampton, VA 23669
(757) 727-0900, ext. 757
http://www.vasc.org/erc

IL, IN, MI, MN, OH, WI
**NASA Glenn Educator Resource Center**
21000 Brookpark Road, MS 8-1
Cleveland, OH 44135
(216) 433-2017
http://www.grc.nasa.gov/WWW/PAO/html/edteachr.htm

AL, AR, IA, LA, MO, TN
**NASA Marshall Educator Resource Center**
U.S. Space and Rocket Center
One Tranquility Base
Huntsville, AL 35758
(256) 544-5812
http:/www1.msfc.nasa.gov/education/erc

MS
NASA Stennis Educator Resource Center
Building 1200
Stennis Space Center, MS 39529
(228) 688-3220
http://education.ssc.nasa.gov/htmls/trc/trc.htm

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